Overview of Selection Process:

For each component within each of the two condition categories (HP/IP and LP) there is a three-phase process that the group of possible materials will be taken through. Materials will be eliminated at each phase if they do not meet the requirements or are on the low end of the ranking scale. The general outline for the selection process is as follows:

After selecting a material for each component within both the HP/IP turbine and the LP turbine we will look at the entire turbine together to assess the economic feasibility. The entire process is described in the following diagram:

LP

HP/IP

Economic assessments of entire plant retrofit vs. new plant construction

Entire Turbine Design

Phase 3

Phase 3

Phase 1

Phase 1

Phase 1

Phase 2

Phase 2

Phase 2

Phase 1

Phase 1

Phase 1

Phase 2

Phase 2

Phase 2

Casing

Casing

Rotor

Rotor

Blades/Nozzles

Blades/Nozzles

Differences in material requirements for the different components and HP/IP and LP turbines stem from the different steam conditions and the function of the component. The different selection methods are outlined in the table to show how each component in each steam condition is assessed.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *Phase 1*  *Phase 2*  *(in order of importance)* | HP/IP | | | LP | | |
| Rotor | Blades | Casing | Rotor | Blades | Casing |
| LMP ≥ 25  Weldable  Machinable | LMP ≥ 25  \*does not need to be  weldable  Machinable | LMP ≥ 25  Weldable  Machinable | LMP ≥ ??  Weldable  Machinable | LMP ≥ ??  \*does not need to be weldable  Machinable | LMP ≥ ??  Weldable  Machinable |
| ++YS  Oxidation  Cost | +YS  Oxidation  Cost | YS  Cost  \*Oxidation not really a factor | +Oxidation  YS  Cost | ++Oxidation  YS  Cost | Oxidation  YS  Cost |

In the HP turbine the steam is coming directly from the boiler and is at the highest temperature and pressure (7600C and ??? mPa). These higher temperatures mean that creep properties are most important, leading to the requirement of a Larson-Miller parameter of 25 or higher and a higher weight for the yield strength rating in phase 2. In the LP turbine the steam is at a lower temperature and pressure. This means that the steam is “wet steam” which makes it more likely to corrode and oxidize the components. This is the reasoning for the higher weight on oxidation in phase 2 and the lower LMP in phase 1.

The blades are not welded to the rotor. They are held into place by a root (see figure ??? in section ???) so weldability is not a factor in phase 1. In LP phase 2, oxidation is most important for the blades as they are directly impacted by the steam jet stream. In HP/IP phase 1 this is also true for the YS as the blades and rotor are more directly affected by the high temperature steam. Oxidation is not very important for the casing in HP/IP for the same reasoning. Cost is always minimized so it is equally important in all components.